

# PROJECT RISK MANAGEMENT HANDBOOK



First Edition

Revision 0

June 26, 2003



*Office of Project Management Process Improvement*

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**Project Risk Management Handbook**  
**June 26, 2003**  
**Rev 0**

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# Preface

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This handbook provides an overview of risk management at the California Department of Transportation (Department).

This version is effective as of July 1, 2003.

The project team thanks all individuals within the regions, districts and headquarters for their support and contributions to the production of the *Project Risk Management Handbook*.

## Purpose

This document describes the basic concepts and processes that guide risk management planning and implementation during project development.

## Audience

Department project managers, functional managers, and staff engaged in the delivery of capital projects.

## Background

The purpose of this handbook is to make the present policy/subject matter more useful and easier to understand.

## Revisions

Revision 0 represents the original version of the 1<sup>st</sup> edition.

## Conventions

Titles of books and other documents appear in *italics*.

Web site URLs appear in ***bold italics***.



*Like this example.*

Additional information, notes, and tips appear in the left margin.





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## OVERVIEW

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This chapter defines:

- ▶ Project risk and risk management
- ▶ The objective of risk management within the Department

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# Why Risk Management?

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The Capital Project Risk Management Process, described in this handbook, is intended to result in the effective management of project risks and opportunities. The project manager, project sponsor, and project team members jointly develop a written plan that enables them to identify, assess, quantify, prepare a response to, monitor, and control capital project risks.

## Definition

*Project risk* is an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project objective. A risk has a cause and, if it occurs, a consequence.<sup>1</sup>

*Risk management* is the systematic process of planning for, identifying, analyzing, responding to, and monitoring project risk. It involves processes, tools, and techniques that will help the project manager maximize the probability and consequences of positive events and minimize the probability and consequences of adverse events. Project risk management is most effective when first performed early in the life of the project and is a continuing responsibility throughout the project.

## Objective

The project risk management process helps project sponsors and project teams to make informed decisions regarding project alternatives. Risk management encourages the project team to take appropriate measures to minimize:

- Adverse impacts to project scope, cost, and schedule
- Management by crisis

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<sup>1</sup>A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 2000 ed., Chapter 11.

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## PROCESS OVERVIEW

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This chapter describes process tasks, their outputs, and key responsibilities of project participants.

# Flow

The project team completes the risk management plan before the project initiation document (PID) component ends. The team updates the plan in each subsequent lifecycle component and continues to monitor and control risks throughout the life of the project.

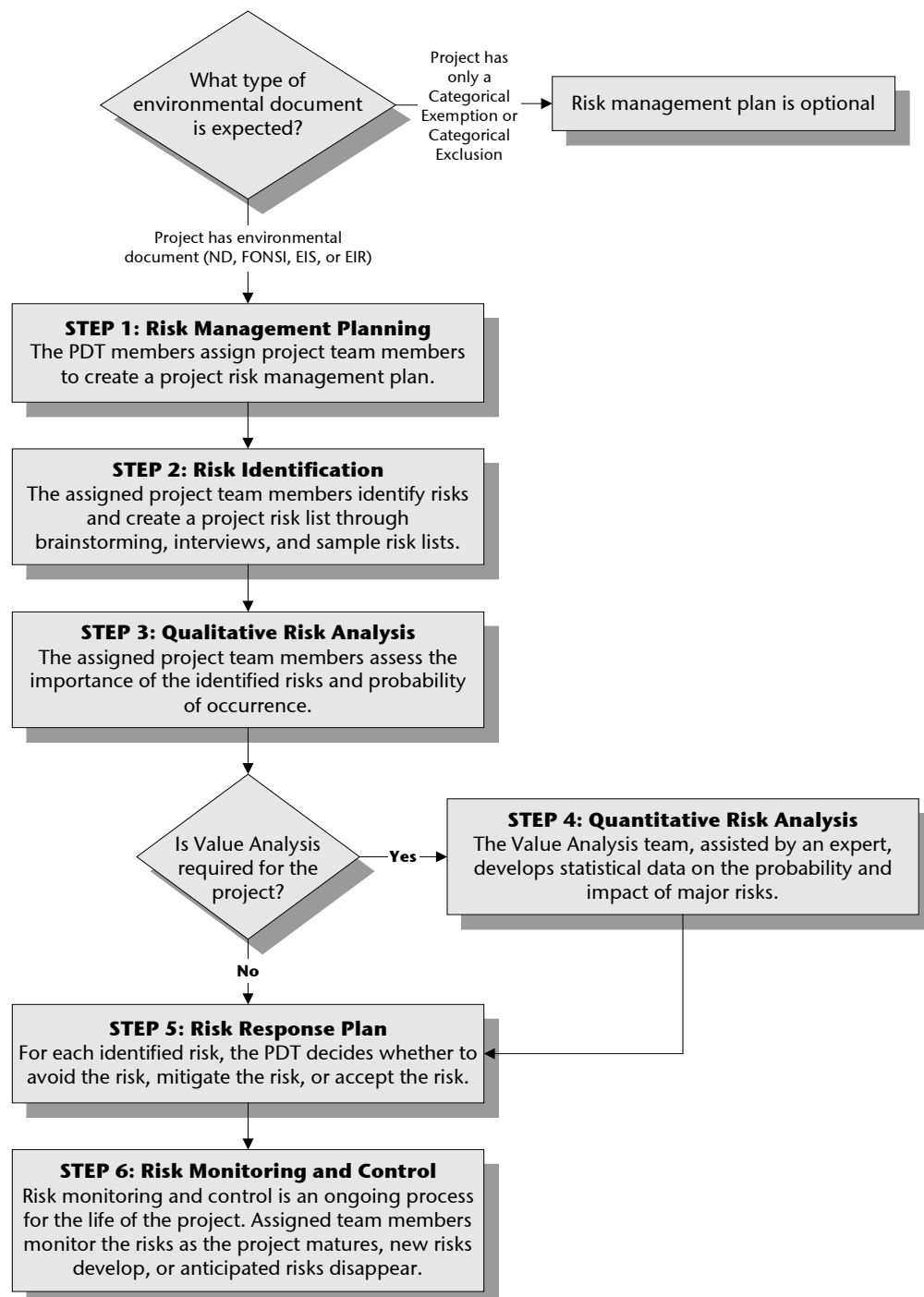


Figure 1. Risk management process flowchart

## Tasks and Outputs

This matrix shows the two main process tasks, the four subtasks, and all of the deliverables associated with project risk management.

Process Tasks		Task Outputs (deliverables)
Risk management planning		Risk management plan
	Risk identification	Project risk list
	Qualitative risk analysis	Prioritized list of risks classified as high, moderate, or low.
	Quantitative risk analysis (Only if the project includes Value Analysis)	An analysis of the project's likelihood of achieving its cost and time objectives
	Risk response planning	Risk response plan, including one or more of the following: residual risks, secondary risks, change control, contingency reserve (amounts of time or budget needed), and inputs to a revised project plan
Risk monitoring and control		Workaround plans, corrective actions, project change requests (PCR), and updates to the risk response plan and to risk identification checklists for future projects

## Key Responsibilities

This matrix shows the six process tasks and the responsibilities of the project manager and stakeholders.

Process Tasks	Role					
	Sponsor	District Division Chief for Program and Project Management	Project Manager	Assistant Project Manager/ Project Management Support Unit	Functional Manager	Task Manager
Risk management planning	S	S	R	S	S	S
Risk identification	S	S	A	S	R	R
Qualitative risk analysis			R	S	S	S
Quantitative risk analysis (Performed only as part of Value Analysis)			A	S	R	R
Risk response planning	S	S	R, A	S		
Risk monitoring and control	R	R	R, A	S	R	R

Legend:

- R = responsible
- S = support
- A = approve

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## PROCESS STEPS

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This chapter identifies and explains the six tasks of risk management.

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## Risk Management Planning

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*Before starting project studies, the project manager establishes a PDT in accordance with Department policy. For details, see the “PDT Formation” sub-section of the Project Development Procedures Manual.*

As part of workplan development, project development team (PDT) members assign project team members to create a project risk management plan.

At this point, the assigned project team members begin to create the risk management plan. The risk management plan identifies and establishes in the project plan the activities of risk management for the project.

If the project will undergo a value analysis (VA), the VA team assists in preparing the risk management plan. If the risk management plan is prepared with a VA study, the risk management plan is included in the VA study report.

To prepare the risk management plan, the assigned project team members use a spreadsheet that shows the risks and responses in an abbreviated form. For a sample of what this spreadsheet might contain, see “Appendix B: Sample Risk Management Plan Spreadsheet” on page 20. An electronic version of the sample spreadsheet is available on the project management guidance Web site at

**<http://www.dot.ca.gov/hq/projmgmt/guidance.htm>**



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## Risk Identification

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Risk identification involves identifying potential project risks and documenting their characteristics. Risk identification results in a deliverable — the project risk list.

The assigned team members identify the potential risks and opportunities, using:

- ▶ The sample risk list provided on page 16
- ▶ Their own knowledge of the project
- ▶ Consultation with others who have significant knowledge of the project or its environment



*Techniques for identifying risks and opportunities are taught in the Department's Value Analysis courses.*

The team considers:

- ▶ Risks — what might go wrong
- ▶ Opportunities — better methods of achieving the project's purpose and need
- ▶ Triggers — symptoms and warning signs that indicate whether each risk is likely to occur

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## Qualitative Risk Analysis

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Qualitative risk analysis assesses the importance of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation. The team assesses each identified risk for its probability of occurring and its impact on project objectives. Sometimes experts or functional units assess the risks in their respective fields and share these assessments with the team.

Team members sort the identified risks into high, moderate, and low risk categories for each project objective (time, cost, scope). They rank risks by degrees of probability and impact, and include their assessment rationale. For more information and a sample, see “Appendix C: Risk Probability Ranking” on page 23.

Team members revisit qualitative risk analysis during the project’s lifecycle. When the team repeats qualitative analysis for individual risks, trends may emerge in the results. These trends can indicate the need for more or less risk management action on particular risks, or whether a risk mitigation plan is working.

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## Quantitative Risk Analysis

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Quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. The result is a probability distribution of the project's cost and completion date based on the risks in the project.

Quantitative risk analysis involves statistical techniques that are most easily used with specialized software. The Department has specialists trained in these techniques and equipped with the necessary software. A specialist is assigned to assist each value analysis team. The team provides the specialist with the data needed to perform the analysis.

### When to Use Quantitative Analysis

The Department does not require quantitative analysis for projects; however, it strongly recommends that projects requiring VA, or those projects with an extremely high risk identified from the qualitative analysis, undergo quantitative risk analysis.

Deputy District Directors for Project and Program Management are responsible for identifying which of their projects will undergo VA during the following fiscal year, and for submitting a list of these projects to the District VA Coordinator. Project managers must arrange for appropriate resources through the functional managers, consultants, and design centers, and must include VA in the project schedules.

For more information about implementing VA, see the following Web site.  
**[http://www.dot.ca.gov/hq/oppd/pdpm/chap\\_hm/chapt19/chapt19.htm](http://www.dot.ca.gov/hq/oppd/pdpm/chap_hm/chapt19/chapt19.htm)**

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## Risk Response Planning

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Risk response planning focuses on the high-risk items evaluated in the qualitative and/or quantitative risk analysis. It identifies and assigns parties to take responsibility for each risk response. This process ensures that each risk requiring a response has an owner.

The project manager and the PDT identify which strategy is best for each risk, and then design specific actions to implement that strategy. These strategies and actions include:

- ▶ **Avoidance.** The team changes the project plan to eliminate the risk or to protect the project objectives from its impact. The team might achieve this by changing scope, adding time, or adding resources (thus relaxing the so-called “triple constraint”). These changes may require a PCR.
- ▶ **Transference.** The team transfers the financial impact of risk by contracting out some aspect of the work. Transference reduces the risk only if the contractor is more capable of taking steps to reduce the risk and does so.
- ▶ **Mitigation.** The team seeks to reduce the probability or consequences of a risk event to an acceptable threshold. They accomplish this via many different means that are specific to the project and the risk. Mitigation steps, although costly and time-consuming, may still be preferable to going forward with the unmitigated risk.
- ▶ **Acceptance.** The project manager and the project team decide to accept certain risks. They do not change the project plan to deal with a risk, or identify any response strategy other than agreeing to address the risk if and when it occurs.

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## Risk Monitoring and Control

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*Residual risks are left over from the previous lifecycle component. Typically, they are not high risks, but could become so under certain conditions.*

Risk monitoring and control keeps track of the identified risks, residual risks, and new risks. It also ensures the execution of risk response plans, and evaluates their effectiveness.

Risk monitoring and control continues for the life of the project. The list of project risks changes as the project matures, new risks develop, or anticipated risks disappear.

Periodic project risk reviews repeat the tasks of identification, analysis, and response planning (see previous tasks). The project manager regularly schedules project risk reviews, and ensures that project risk is an agenda item at all PDT meetings. Risk ratings and prioritization commonly change during the project lifecycle.

If an unanticipated risk emerges, or a risk's impact is greater than expected, the planned response may not be adequate. The project manager and the PDT must perform additional response planning to control the risk.

Risk control involves:

- ▶ Choosing alternative response strategies
- ▶ Implementing a contingency plan
- ▶ Taking corrective actions
- ▶ Re-planning the project

The functional manager assigned to each risk reports periodically to the project manager and the risk team leader on the effectiveness of the plan, any unanticipated effects, and any mid-course correction that the PDT must take to mitigate the risk.





# APPENDICES

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This chapter provides the documents referenced in the text.

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## Appendix A: Sample Risk List

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The task of risk identification produces a project risk list. The project team then puts the risks into categories and assigns each risk to a team member.

The project team members may use this sample risk checklist to develop a specific project risk list. This list is not meant to be all-inclusive; it is just a guide. Team members add other risks areas from previous project results and as they arise during the project. Such sources might include:

- Final project reports
- Risk response plans
- Organized lessons learned
- The experience of project stakeholders or others in the organization
- Published information such as commercial databases or academic studies

### Technical Risks

- Design incomplete
- Right of Way analysis in error
- Environmental analysis incomplete or in error
- Unexpected geotechnical issues
- Change requests because of errors
- Inaccurate assumptions on technical issues in planning stage
- Surveys late and/or surveys in error
- Materials/geotechnical/foundation in error
- Structural designs incomplete or in error
- Hazardous waste site analysis incomplete or in error
- Need for design exceptions
- Consultant design not up to Department standards
- Context sensitive solutions
- Fact sheet requirements (exceptions to standards)



**External Risks**

- Landowners unwilling to sell
- Priorities change on existing program
- Inconsistent cost, time, scope, and quality objectives
- Local communities pose objections
- Funding changes for fiscal year
- Political factors change
- Stakeholders request late changes
- New stakeholders emerge and demand new work
- Influential stakeholders request additional needs to serve their own commercial purposes
- Threat of lawsuits
- Stakeholders choose time and/or cost over quality

**Environmental Risks**

- Permits or agency actions delayed or take longer than expected
- New information required for permits
- Environmental regulations change
- Water quality regulation changes
- Reviewing agency requires higher-level review than assumed
- Lack of specialized staff (biology, anthropology, archeology, etc.)
- Historic site, endangered species, wetlands present
- EIS required
- Controversy on environmental grounds expected
- Environmental analysis on new alignments is required
- Formal NEPA/404 consultation is required
- Formal Section 7 consultation is required
- Section 106 issues expected
- Project in an area of high sensitivity for paleontology
- Section 4(f) resources affected
- Project in the Coastal Zone
- Project on a Scenic Highway
- Project near a Wild and Scenic River
- Project in a floodplain or a regulatory floodway

- Project does not conform to the state implementation plan for air quality at the program and plan level
- Water quality issues
- Negative community impacts expected
- Hazardous waste preliminary site investigation required
- Growth inducement issues
- Cumulative impact issues
- Pressure to compress the environmental schedule

### **Organizational Risks**

- Inexperienced staff assigned
- Losing critical staff at crucial point of the project
- Insufficient time to plan
- Unanticipated project manager workload
- Internal “red tape” causes delay getting approvals, decisions
- Functional units not available, overloaded
- Lack of understanding of complex internal funding procedures
- Not enough time to plan
- Priorities change on existing program
- New priority project inserted into program
- Inconsistent cost, time, scope and quality objectives

### **Project Management Risks**

- Project purpose and need is poorly defined
- Project scope definition is poor or incomplete
- Project scope, schedule, objectives, cost, and deliverables are not clearly defined or understood
- No control over staff priorities
- Too many projects
- Consultant or contractor delays
- Estimating and/or scheduling errors
- Unplanned work that must be accommodated
- Communication breakdown with project team
- Pressure to deliver project on an accelerated schedule

- Lack of coordination/communication
- Lack of upper management support
- Change in key staffing throughout the project
- Inexperienced workforce/inadequate staff/resource availability
- Local agency issues
- Public awareness/support
- Agreements

**Right of Way Risks**

- Utility relocation may not happen in time
- Freeway agreements
- Railroad involvement
- Objections to Right of Way appraisal takes more time and/or money

**Construction Risks**

- Inaccurate contract time estimates
- Permit work windows
- Utility
- Surveys
- Buried man-made objects/unidentified hazardous waste

**Regulatory Risks**

- Water quality regulations change
- New permits or new information required
- Reviewing agency requires higher-level review than assumed

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## Appendix B: Sample Risk Management Plan Spreadsheet

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Using the sample risk list (Appendix A), the assigned project team members add their specific information to the risk management plan spreadsheet.

The following illustration shows a sample Excel spreadsheet that represents one possibility for what a risk management plan spreadsheet might include.

An electronic version of this sample spreadsheet is available on the project management guidance Web site at

***<http://www.dot.ca.gov/hq/projmgmt/guidance.htm>***

Figure 2. Risk management plan spreadsheet sample



## Appendix C: Risk Probability Ranking

Using established methods and tools, qualitative risk analysis assesses the probability and the consequences of each identified risk to determine its overall importance. Using these tools helps to correct biases that are often presented in a project plan. In particular, careful and objective definitions of different levels of probability and impact are the keys to the credibility of the results.

### ► To rank risks by probability and impact:



*For more information about risk probability ranking, see chapter 11 of the PMBOK.*

**Step 1:** Set up a matrix to match a percentage (probability of risk) to a ranking number. Department project managers often use the matrix shown below, but they can set up a different matrix if it would better suit the project.

Risk Probability Ranking	
Ranking	Probability of Risk Event
5	80–99%
4	60–79%
3	40–59%
2	20–39%
1	1–19%

**Step 2:** Set up a matrix to match the objective (time, cost, and scope) to a defined impact. Department project managers often use the impact numbers shown in the matrix below, but they can choose others if it would better suit the project.

Evaluating Impact of a Risk on Major Project Objectives						
Impact		1	2	4	8	16
Objective	Time	Insignificant schedule slippage	Delivery plan milestone delay within quarter	Delivery plan milestone delay of one quarter	Delivery plan milestone delay of more than one quarter	Delivery plan milestone delay outside fiscal year
	Cost	Insignificant cost increase	<5% cost increase	5–10% cost increase	10–20% cost increase	>20% cost increase
	Scope	Scope decrease is barely noticeable	Changes in project limits or features with <5% cost increase	Changes in project limits or features with 5–10% cost increase	Sponsor does not agree that scope meets the purpose and need	Scope does not meet purpose and need

**Step 3:** Combine the data from the two previous steps. Each risk appears in its own probability and impact (PxI) matrix.

The PDT uses a PxI matrix to combine each risk's probability and impact. These matrices establish whether each risk is high, moderate, or low. The risks can then be displayed by high, moderate, and low groupings for each of the three objectives (time, cost, and scope). Department project managers often use the PxI matrix shown below, but they can set up a different matrix and assign different scores if it would better suit the project.

Translate Score to Risk Rank		Time, Cost, and Scope Objectives Large Aversion to High & Very High Impacts					
Score	Risk	Probability					
1 – 6	Low	5	5	10	20	40	80
7 – 14	Moderate	4	4	8	16	32	64
15 – ++	High	3	3	6	12	24	48
		2	2	4	8	16	32
		1	1	2	4	8	16
			1	2	4	8	16
			Impact				

Figure 3. Sample PxI matrix

Some Department project managers use a PxI matrix based on narrative probabilities and impacts (very low, low, moderate, high, very high) rather than numerical ones. For a sample of this type of matrix, see “Appendix B: Sample Risk Management Plan Spreadsheet” on page 20.



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## Appendix D: References

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For more information about risk and risk management, see:

- ▶ Chapter 11 of *A Guide to Project Management Body of Knowledge* (PMBOK® Guide), 2000 Edition
- ▶ Chapter 11 of the *Government Extension to a Guide to the Project Management Body of Knowledge*, 2000 Edition
- ▶ *Department Guide to Capital Project Work Breakdown Structure*, Release 5.1





# GLOSSARY

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<b>Contingency Reserve</b>	The amount of money or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization.
<b>Decision Tree</b>	A diagram used to select the best course of action in uncertain situations.
<b>Environmental Document</b>	The National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) require certain environmental documentation for transportation projects. Types of documents include a negative declaration (ND) finding of no significant impact (FONSI), or an environmental impact study (EIS)/environmental impact report (EIR).
<b>Impact</b>	Effect or consequence.
<b>Milestone</b>	A significant event in the project, usually completion of a major deliverable.
<b>Mitigation</b>	The act of alleviating a harmful circumstance. Risk mitigation seeks to reduce the probability and/or impact of a risk to below an acceptable threshold.
<b>Probability</b>	Likelihood of the occurrence of any event.

<b>Project Change Request</b>	Any significant changes to the scope, cost, or schedule of a programmed project (STIP, SHOPP, or TCRP) or special program project (toll seismic retrofit, soundwall) require a revision to the delivery commitment. <sup>2</sup>
<b>Project Development Team</b>	An interdisciplinary team, composed of key members of the project team as well as external stakeholders, that acts as a steering committee in directing the course of studies required to evaluate the various project alternatives during the early components of the project lifecycle.
<b>Project Initiation Document</b>	Concept approval document for candidate projects that contains: <ul style="list-style-type: none"> <li>▶ A defined project scope</li> <li>▶ A reliable capital and support cost estimate for each alternative solution</li> <li>▶ A project schedule (workplan) for the alternative recommended for programming the project</li> </ul>
<b>Project Objective</b>	A particular goal of a project. All projects have these four objectives: <ul style="list-style-type: none"> <li>▶ Scope</li> <li>▶ Schedule</li> <li>▶ Cost</li> <li>▶ Quality</li> </ul>
<b>Risk Officer</b>	A person other than the project manager assigned to monitor and maintain the project risk management plan.
<b>Scope</b>	Encompasses the work that must be done to deliver a product with the specified features and functions.
<b>Value Analysis</b>	A multi-disciplined team systematically applies recognized techniques to: <ul style="list-style-type: none"> <li>▶ Identify the function of a product or service</li> <li>▶ Establish a worth for that function</li> <li>▶ Generate alternatives through the use of creative thinking</li> <li>▶ Reliably provide the needed functions at the lowest overall cost</li> </ul> <p>The term is often interchanged with Value Engineering.</p>
<b>Value Analysis Team</b>	A team that performs value engineering.
<b>Workplan</b>	A resourced schedule. The workplan identifies the project-specific WBS elements and defines the cost, timeline, and requirements for each. The current workplan guides the day-to-day operations of project execution and project control.

<sup>2</sup> Project Change Requests, memo dated September 21, 2002, Number 006  
[http://pm.dot.ca.gov/ProjectOffice/ProcessGuidance\\_Directives/Guidance\\_DirectivesHome.asp](http://pm.dot.ca.gov/ProjectOffice/ProcessGuidance_Directives/Guidance_DirectivesHome.asp)



# ACRONYMS

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<b>CEQA</b>	California Environmental Quality Act
<b>EIR</b>	Environmental Impact Report
<b>EIS</b>	Environmental Impact Study
<b>FONSI</b>	Finding of No Significant Impact
<b>ND</b>	Negative Declaration
<b>NEPA</b>	National Environmental Policy Act
<b>PCR</b>	Project Change Request
<b>PDT</b>	Project Development Team
<b>PID</b>	Project Initiation Document
<b>PMBOK</b>	Project Management Body of Knowledge
<b>PSR</b>	Project Study Report
<b>PxI</b>	Probability and Impact
<b>SHOPP</b>	State Highway Operation & Protection Program

<b>STIP</b>	State Transportation Improvement Program
<b>TCRP</b>	Traffic Congestion Relief Program
<b>VA</b>	Value Analysis
<b>WBS</b>	Work Breakdown Structure



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